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ABSTRACT

A system to determine cost effectiveness of class size should be based on both budgeted and actual expenditures and credit hours at the individual course section level. These two factors, in combination, are often expressed as cost per credit hour, and this statistic forms the primary means of evaluating planned "inputs" against actual "outputs." For purposes of determining a cost-effective class size, it is not as important that fewer dollars were spent than were budgeted, or that credit hours generated exceeded or fell short of those planned. Rather, it is the control of the proportional relationship between these two factors which, if attained, can improve efficiency. Generally, the relationship between expenditures and credit hours should be close. However, budgeting these factors at the section level is not likely to increase planning accuracy--many enrollment influences are beyond the control of planners. Additionally, several problems exist in implementing this type of cost effectiveness analysis. The cost of budgeting at the section level is likely to be prohibitive, and factors such as contractual obligations with the faculty, the nature and fluctuation of student enrollments, and student preferences for classes may all impair administrative ability to obtain optimum class sizes. Hypothetical cases are used to demonstrate the system, and an appendix considers the problems of assigning indirect costs at the section level. (DR)

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# Factors in the Determination of Cost Effective Class Sizes

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KALAMAZOO VALLEY COMMUNITY COLLEGE
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## Introduction

The purpose of this project was to identify and discuss various elements that may be necessary components in a system for determining a "cost effective" class size. Included is background information essential to understanding the strengths and weaknesses of these elements, with appropriate examples.

## Basic Tenents

Before presenting the essential elements of a system to determine cost effective class size, a short discussion of the term "cost-effective" may be in order. In Anderson, et al's volume Encyclopedia of Educational Evaluation, cost effectiveness analysis is defined as one which "attempts to provide an answer to the question of how total cost and optimal choice of inputs vary as a function of prices and the target output". Cost effective analysis is closely associated with cost benefit analysis, but does not include an attempt to assign some measure of value (benefit) to a variety of possible outputs, as does cost benefit analysis.

Both these types of analyses are systems analyses, which Anderson defines as "an attempt to minimize dollar costs for any specified outcome, or, conversely, to maximize benefits for a given cost." All of these terms emanate from industrial production, in which the costs of inputs (raw materials) are minimized while output (products) is maximized. In industry, a Pareto's inefficiency exists if the firm fails to choose a production strategy which could have produced more valuable output or less costly input. The value of a production strategy can be expressed as the difference between the value of the outputs and the value (cost) of the inputs -- it represents the gain or profit.

Application of cost effectiveness concepts to education has not

met with great success thus far. The central problems are: a) inability to assign a dollar value to educational outputs, and b) lack of alternative "production strategies" to lessen input costs or increase output values. According to Anderson, "probably the most important aspect of (cost effectiveness analysis) is the creative task of generating alternative strategies." As discussed later in this report, the development of alternative strategies for controlling class size is severely impeded by several factors.

Another problem in the application of cost effectiveness concepts to education lies in the fact that we do not operate in a profit system. Since the College cannot "make a profit", one side of the cost effectiveness equation, the value of outputs, cannot be measured in the same fashion as the cost of inputs -- instructional expenditures, in our case.

Given the structure of the College, the measurable inputs in analyzing class size cost effectiveness are instructional expenditures made to produce a course section of N students or N credit hours. These "inputs" can be assessed in terms of their proximity to the expenditures budgeted for production of the same number of student credit hours. The basis for determining cost effective class sizes would be planned versus actual expenditures made to produce planned versus actual credit hours, at the individual course section level. These two factors, in combination, are often expressed as cost per credit hour, and this statistic would form the primary "measuring stick" in evaluating planned "inputs" against actual "outputs".

Basis for Determining Cost Effectiveness of Class Size

The mean average cost per credit hour is budgeted each fiscal year, based on anticipated expenditures and credit generation. For the 1978-79 fiscal year, the budgeted mean cost per credit hour is expected to be $74.11, and is based on $7,103,859 total expenditures and 95,852 total credit hours. As required by law, the College's expenditures cannot exceed revenues. If, therefore, fewer than 95,852 credit hours are generated, the mean cost per credit hour will be greater than $74.11, if budgeted dollars are expanded. Conversely, an increase in credit hour generation over the budgeted figure of 95,852 would result in a lower cost per credit hour at the same level of budgeted expenditures.

Example 1

| | FY1977-78 | |
|---|---|---|
| | Planned | Actual |
| Expenditures | $7,050,000 | $6,419,798 |
| Credit Hours | 105,400 | 91,547 |
| Mean Cost per Credit Hour | $66.80 | $70.10 |

As shown in example 1, credit hour generation and expenditures attained were lower than planned. The reduction in expenditures, however, was not great enough to hold the mean cost per credit hour at the planned level.

To evaluate the cost effectiveness of class sizes, we must make the section the unit of analysis -- in example 1, the College was the unit of analysis. The number of sections expected to run during FY1978-79 is 1,390. The mean cost per section would then be $5,110.60, or $7,103,859 (total budgeted expenditures) divided by 1,390. The mean number of credit hours

per section, then, is planned at 68.9 ($5,110.60 divided by $74.11, or 95,852 divided by 1,390).

Since 68.9 is the mean credit hours per section necessary to maintain a $74.11 per credit hour cost, actual credit hours per section will cluster about that mean. To monitor class size, in terms of credit hours, for the purposes of making adjustments necessary to maintain a mean $74.11 per credit hour (or maintain cost effectiveness), one must have more information than the mean credit hours per section. Actual expenditure data would also be needed.

Example 2 — Assume the direct instructional cost per credit hour budgeted for a cost center is applicable at the course level, for purposes of this business cost center example.

| | Registered Credit Hours | Direct Instructional Cost @ $25.85 per Credit Hour |
|---|---|---|
| Section A | 75 | $1,939 |
| Section B | 54 | 1,396 |
| Section C | 111 | 2,869 |
| | 240 | $6,204 |

Mean CH per section: 80.0
Mean Cost per CH: $25.85

In example 2, the section size would be cost effective: the mean credit hours per section are greater than planned for the College overall, while the mean cost per credit hour is at the planned level for this course.[1]

In reality, however, direct instructional costs for given sections of our hypothetical business course will range about the mean of $25.85 per

1. If this were actually done, one would need to have the planned mean credit hours per section for the course, rather than the total institution mean.

credit hour, for both planned and actual costs. One section may be taught by a part-time instructor:

Example 3: Hypothetical Business Course

| | Registered Credit Hours | Direct Cost (variable) | Cost per Credit Hour |
|---|---|---|---|
| Section A | 75 | $1,939 | $25.85 |
| Section B | 54 | 350 | 6.48 |
| Section C | 111 | 4,131 | 37.22 |
| | 240 | $6,420 | |

Mean CH per section: 80.0
Mean cost per CH: $26.75

In example 3, the mean credit hours per section are above the budgeted mean, but the mean direct instructional cost per section is $ .90 over the $25.85 budgeted mean for this course.

These examples were given to emphasize that direct instructional cost per section should be budgeted in order to have a clear picture of cost effective class size. In example 3, Section C had the highest credit hour generation but the relatively high cost of that section resulted in a high cost per credit hour. Presumably, one would attempt to increase enrollment in Section B, at the lower cost per credit hour, in order to offset the high cost of Section C. Such action could not be taken unless direct costs, both planned and actual, are known at the section level of analysis.

To restate, the basic elements of a system to determine class size cost effectiveness would be planned and actual credit hours of a given section, and the budgeted and actual direct instructional costs of that section.

Indirect Cost Considerations

A discussion of methods for allocating indirect costs to individual course sections is attached as Appendix A. Indirect costs should be included in any system to assess cost effective class sizes. Instructional administrators, however, exercise little direct control over these costs, which are similar to fixed expenditures. As shown in Appendix A, the only viable method for instructional administrators to reduce indirect costs per section would be to increase credit hour generation without a corresponding increase in expenditures.

Assuming that it is both possible and practical to compute a budget, and thus a desirable cost per credit hour, for each section offered, there are other factors of importance in determining and maintaining cost effective class sizes. These are presented separately in the following sections.

Accuracy of Planning

The optimum enrollment determined for a section would be based on planning: budgeted direct costs and budgeted credit hours. How accurate can we expect such planning to be? Example 1 gave an indication of the differences between budgeted and actual expenditures and credit hours for FY1977-78, for the entire institution. Appendix B presents the percentage increase or decrease, from budgeted to actual, expenditures and credit hours for each instructional cost center in FY1977-78. Cost centers are currently the smallest unit of analysis used in budget preparation, which have an attached credit hour production figure.

For purposes of determining a cost effective class size, it is not as important that fewer dollars were spent than budgeted, or that

credit hours generated exceeded or fell short of those planned. Rather it is the relationship between these two factors which becomes important. Generally, the relationship between expenditures and credit hours should be closely related: if actual credit hours decrease, direct costs should decrease; and an increase in credit hours should effect an increase in direct costs, even if these increases or decreases are not directly proportional.

In the 1977-78 fiscal year, however, there were several exceptions to this proposition, as summarized below from the data in Appendix B:

Division 1

Actual expenditures 1.0% less than budgeted.
Actual credit hours 16.3% less than budgeted.

Four cost centers showed an increase in expenditures from budgeted to actual, and a decrease in credit hours, from budgeted to actual.

Division 2

Actual expenditures 5.0% greater than budgeted.
Actual credit hours 9.6% less than budgeted.

Two cost centers showed an increase in expenditures, from budgeted to actual, while credit hours decreased. Two cost centers had a decrease in expenditures, from budgeted to actual, while credit hours increased.

Division 3

Actual expenditures 7.6% less than budgeted.
Actual credit hours 8.7% less than budgeted.

Five cost centers show a decrease in expenditures from budgeted to actual, while credit hours increased.

At the cost center level, planning was quite inaccurate; 13 cost centers (32%) showed a disproportional relationship between credit hour production and expenditures. Budgeting these factors at the section level, or even

course level, is not likely to increase planning accuracy. There would not be an opportunity for errors to offset each other and "balance out" in the form of a cost center average. This is not a criticism of planning. Many factors beyond the control of planners influence enrollments. One major factor is the "open-door" admissions policy, under which a college is usually reluctant to limit the number of students admitted, number admitted in a particular field, or number of credit hours for which a student registers. Tracking students through programs is problematic in all but a few areas. If planning could insure that a given number of students would be required to enroll in a particular course next semester, other factors such as preferred instructor and class time would also be minimized.

Another circumstance has tremendous implications for controlling class size to minimize expenditures: faculty affiliation with a bargaining unit.

Faculty Contract

In various instances, it would not be feasible to maintain a desirable class size while meeting terms of the faculty contract. For example, an ENG 108 course has enrolled 15 students, 10 below the desired 25. Unless the faculty member assigned to that class could be given other, more productive assignments, it would not be efficient to cancel the ENG section and remain obligated for a salary which was to have included that section. Also, if the alternative assignment were to an indirect cost area such as instructional support, the mean cost per credit hour for direct instructional costs would be reduced.

In other instances, class size ranges, with non-overload maximums, have been contractually set, and may be below the actual cost effective class size. This type of situation could only be remedied through contract negotiations.

Finally, action taken to maintain a cost effective class size could produce a faculty overload situation, resulting in additional non-planned cost, which would negate the corrective action taken to maintain cost effective class size.

Such "non-cost effective" sections could be offset to some degree by other sections, as noted in example 3, if students could be influenced to enroll in the low-cost sections. A data system to monitor class size would have to be extremely elaborate, however, to reflect such offsets on a timely basis. More problematic than the data system would be the ability (latitude) of instructional planners to make shifts in assignments or in enrollments, even if "high-cost" sections were identified.

Prohibitive Cost

The expense of developing and maintaining a system to determine and then monitor "cost effective class size" would, in all probability, be prohibitive. We would need to:

1. Revise the current budgeting system to include budgeted direct costs and budgeted credit hours at the section level.

2. Have the capability to instantly reflect, during registration, changes in the figures budgeted. This must include an analysis of the effect one section change (cancellation, faculty overload situation, etc.) would have on all other sections of that course, discipline, division, or all sections.

3. Negotiate changes in the faculty contract to allow cost effective class size to occur, in instances where the contract obligations prevent appropriate corrective action.

4. Improve planning, such that credit hour generation and direct cost remain proportional, and allow the time necessary to plan at the section level.

Summary

A system to determine cost effectiveness of class size should be based on both budgeted and actual expenditures and credit hours at the

section level of analysis. The cost of budgeting at that level may be prohibitive, in terms of administrative time needed; it is also not expected to be accurate. Factors such as contractual agreements with the faculty, nature of student enrollments, and student preferences would impair administrative ability to make changes necessary to maintain desired class sizes.

Examination of this concept need not be unproductive. Administrators do budget expenditures, forecast enrollments, and make adjustments to improve efficiency of production. By maintaining a careful watch on credit hour generation, at various levels of analysis, the College can determine in what areas expenditures should be reduced or increased. Although expenditures may not match the budget, and credit hours may not match projections, a better control of the proportional relationship between the two can be attained and should improve efficiency.

APPENDIX A

Indirect Costs

There are two methods for assigning indirect costs at the section level. The first would be an allocation based on student credit hours planned and produced at the section level. Using fiscal year 1979 data, the mean indirect cost per credit hour, for the entire College, would be $36.84, or the $3,531,558 budgeted for indirect costs divided by 95,852 expected credit hours. Using this mean indirect cost per credit hour, indirect cost per section could be computed as the number of section credit hours multiplied by $36.84. A problem with this method of allocation is that a section which produces a relatively high number of credit hours does not necessarily incur a greater proportion of indirect costs.

Another method could be based on indirect costs, budgeted and incurred, as a section average. For FY1977-78, this method would have produced, for the entire institution:

| | Planned | Actual |
|---|---|---|
| Indirect Expenditures | $3,373,916 | $2,958,342 |
| Sections Run | 1,886 | 1,873 |
| Indirect Cost per Sect. | $1,789 | $1,579 |

For FY1978-79, the mean indirect cost per section is budgeted to be $2,540.68, or $3,531,558 divided by the 1,390 sections planned. The methods for reducing this mean indirect cost per section would be by increasing credit hours without increasing costs, or by decreasing indirect costs. The example following depicts the relationship between credit hours

produced by a section and indirect cost for those sections, assuming the 68.9 mean credit hours per section planned is attained:

| | Mean Indirect Cost per Section | Credit Hours Registered | Indirect Cost Per SCH |
|---|---|---|---|
| Section A | $2,541 | 69 | $36.82 |
| Section B | $2,541 | 99 | $25.66 |
| Section C | $2,541 | 39 | $65.15 |

As seen above, indirect cost per section will not be reduced, regardless of section credit hour generation, as long as the average credit hours per section remains as budgeted. If Section C had enrolled, for example, 60 credit hours, the mean credit hours per section would have exceeded 68.9, and total credit hours would exceed 95,852, thus reducing the mean indirect cost per section.

A problem with attempting to increase registered credit hours, in order to reduce indirect cost per section, is that direct instructional costs may increase at a higher rate than indirect costs decrease.

This cursory look at indirect costs is presented for the reader's information. Instructional administrators cannot directly control most indirect costs.

APPENDIX B

Direct Cost and Credit Hours Comparison

Percentage Change from Budgeted to Actual
FY1977-78

| | Cost Center | Percent Direct Cost Increase (Decrease) | Percent Credit Hour Increase (Decrease) |
|---|---|---|---|
| Division 1: | | | |
| | 010 | ( 3.2) | (27.4) |
| | 011 | (18.2) | (22.9) |
| | 012 | (11.3) | (29.8) |
| | 013 | (19.0) | (50.4) |
| | 014 | 7.1 | 3.6 |
| | 383 | (31.8) | (19.9) |
| | 387 | ( 9.2) | (16.6) |
| | 020 | 34.4 | (24.1) |
| | 030 | 12.7 | 7.6 |
| | 031 | ( 8.3) | (26.4) |
| | 041 | 67.6 | 7.6 |
| | 050 | 7.9 | 11.3 |
| | 040 | ( 7.8) | (11.9) |
| | 044 | 45.7 | (22.6) |
| | 080 | 40.0 | (33.4) |
| | 395 | (100.0) | (95.8) |
| | 090 | 2.6 | ( 9.2) |
| | 386 | (31.6) | (27.6) |
| | Division 1: | ( 1.0) | (16.3) |
| Division 2: | 060 | 15.3 | 21.0 |
| | 061 | 1.2 | ( 3.2) |
| | 062 | (11.6) | 4.4 |
| | 396 | (13.5) | (30.0) |
| | 205 | (19.7) | (57.0) |
| | 206 | 76.8 | - |
| | 210 | 15.7 | 9.4 |
| | 220 | 3.3 | (11.6) |
| | 240 | (16.2) | 5.3 |
| | 250 | ( 9.0) | (14.4) |
| | Division 2: | 5.0 | ( 9.6) |

Appendix B, continued

| | Cost Center | Percent Direct Cost Increase (Decrease) | Percent Credit Hour Increase (Decrease) |
|---|---|---|---|
| Division 3: | | | |
| | 110 | 0.4 | 25.9 |
| | 140 | ( 1.9) | (29.4) |
| | 170 | (10.7) | 15.3 |
| | 398 | (27.5) | 17.2 |
| | 320 | 13.7 | 9.4 |
| | 350 | (17.6) | 23.1 |
| | 381 | (36.1) | ( 2.4) |
| | 384 | (15.9) | ( 6.4) |
| | 330 | 4.1 | 36.0 |
| | 340 | (26.6) | (73.2) |
| | 380 | 7.5 | 14.1 |
| | 335 | (17.6) | 91.7 |
| | 150 | ( 4.7) | 20.3 |
| | Division 3: | ( 7.6) | 8.7 |
| | College Total: | ( 1.1) | ( 8.4) |

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